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# Firm survival and turnover: Do Legal Form, Local Competition, Productivity, and profitability Matter for Firms in Senegal?

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## Abstract

This paper documents the determinants of firms' probability of exiting from 2008 to 2020 in Senegal. We analyze to what extent productivity, location, local competition, and legal form status affected the movements of firms operating in Senegal between 2008 and 2020. Our findings are summarized as follows. Several firm characteristics, including the firm's age and size, affect the firm probability of exiting. Interestingly, spendings in Research and Development (R&D) decrease a firm's likelihood of leaving. Regarding the location, the results suggest that firms outside the capital have a higher market exit probability than those in Dakar. Moreover, the results indicate the importance of local competition in the survival of firms. Indeed, the number of firms in the location sector and an inverse Hirschman-Herfindahl Index (how monopolistic the sector is in the location) increase the probability of exiting. The results also indicate that more productive firms are less likely to exit. Using a microeconomic model, we also assess whether the Cournot model is relevant to the Senegalese firms and economy. The results indicate that that is the case and that our profitability measures derived from the Cournot model are highly significant determinants of firm dynamics (entry and exit movements) for all sectors.

**JEL classifications:** D22, D24, O3, 04

**Keywords:** Total factor productivity (TFP); Legal form; firm exit; firm exit; Senegal; local competition

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## **1 Introduction**

Production is crucial and allows a country to generate wealth. It consists of a process by which an economic agent mobilizes resources to make available goods and services subject to exchange, distribution, and consumption. Any increase in production level leads to economic growth, usually measured by Gross Domestic Product (GDP) (Easterly and Levine 2001). This growth can then improve agents' well-being and the country's development on a larger scale. Thus, understanding the production process is of growing interest in the economic literature and for policymakers, especially in developing countries (Harhoff, Stahl, and Woywode 1998; Abdo Ahmad and Fasih 2021; Škare and Hasić 2016).

Production takes within firms whose behaviours and decisions are governed by their characteristics and market mechanisms. Extensive literature has been developed to model the behaviour of producers to grasp the mechanisms underlying the various decisions they make on the market, in particular those leading them to initiate a process of production or to end it. Indeed, these decisions of entry or exit of firms from a market play a crucial role in production and innovation within an economy.

Many studies have explored firms' exit and turnover; and addressed the issue, ranging from theoretical models to the empirical validation of these theoretical models. Several variables are identified as determinants firms' participation in the market. The literature has documented productivity as one of these key driving keys of the probability of exit of a firm. Indeed, previous studies have shown the importance of productivity on firms' market participation in Ghana (Fraser 2005), Morocco (Hallward-Driemeier and Thompson 2009a), and Ethiopia (Jones, Mengistae, and Zeufack 2018). In addition, other firms' characteristics are identified as factors behind firms' probability of exiting the market. Prior literature has established that location and competition are among the factors driving firms' survival.

Additional studies are required to understand the key tenets of firm behaviours, especially in developing countries. The main focus of this paper is to explore the determinants of a

firm's probability of exiting in Senegal. The main objective of this document is to corroborate previous findings and to go beyond by using the case of firms in Senegal. More precisely, we analyze to what extent productivity, location, local competition and legal status affect the turnover of firms operating in Senegal between 2008 and 2020. A large gap has to be filled in this literature due to the importance of knowing the firms' behaviours and determinants of market participation in implementing policies. This will also help expand and corroborate existing findings in the literature in the case of Senegal or to serve as a basis for comparison with those already existing for other countries.

The results suggest that a variety of firm characteristics, including the firm's age and size, affect the firm probability of exiting. Research and Development (R&D) spendings decrease a firm's likelihood of exiting, and firms outside the capital have a higher market exit probability than those in Dakar. Moreover, the results indicate the importance of local competition in the survival of firms. Indeed, the number of firms in the location sector and an inverse Hirschman-Herfindahl Index (how monopolistic the sector is in the location) increase the probability of exiting. Regarding firm productivity, the results indicate that more productive firms are less likely to exit. A microeconomic model is also used to assess whether the Cournot model is relevant to the Senegalese firms and economy. The results indicate that that is the case and that for all sectors, our profitability measures derived from the Cournot model are highly significant determinants of firm dynamics (entry and exit movements).

The paper is organized as follows: Section 2 presents the data used in the framework of this work. Section 3 investigates the determinants of the probability of exiting for firms. Section 4 assesses the relevance of the Cournot model to the production process of Senegalese firms and economy and if so whether the profitability derived from the Cournot model is determinant to firm turnovers. Section 6 concludes.

## **2 Data**

In the framework of this study, we use data from the *Banque de Données Économiques et Financières* (BDEF) of the Senegalese National Statistics Office, ANSD. The dataset is a census of formal firms. It comes as a result of the aggregation of data provided by

companies through statistical and tax declarations supplemented by estimates for those in activity for which accounting documents are not available. The dataset covers firms established in Senegal which are subject to the West African accounting system chart of accounts (SYSCOA). Companies are classified into four groups according to their primary activity: i) Construction, ii) Trades Services, iii) Manufacturing, and iv) Services. One of the main advantages of this dataset is that it synthesizes data from more than 20,000 companies operating in Senegal over the period 2008-2020. This makes it a valuable source of information. It is also essential to mention that some firms were excluded to the final modelling due to certain inconsistencies, outliers, missing identifiers. The final estimates are based on a set of 18,719 firms. Figure provides the density of firms while Table 3 gives some descriptive statistics the variables of interest.

### 3 Determinants of firm exit

#### 3.1 Econometric model

The mixed-effects survival models, containing both fixed and random effects are considered. Survival models have a trivariate response  $(t_0, t, d)$ :

Where  $t_0$  is the starting time under observation  $t_0 > 0$

$t$  is the ending time under observation  $t > t_0$

$d$  is an indicator for failure and ranges between 0 and 1

The survival function for a given family is the complement of the cumulative distribution function:  $S(t) = 1 - F(t)$

$$h(t_i) = h_0(t_i) * \exp(X_i' \beta + Z_i' u_j)$$

Where  $h(t_i)$  the hazard ratio for the firm  $i$ ,  $X_{it}$  is the vector of explanatory variables while  $\beta$  is the coefficients vector.  $Z_{it}$  is the vector of variables.

### **3.2 Construction of variables of interest**

To understand the firms' turnover in Senegal, a certain number of BDEF variables were chosen or constructed based on the literature and their availability in the database. These can be classified into three groups: i) the movement variable (exit) that constitutes our dependent variable; ii) the firm variables; iii) and the agglomeration variables. These last two categories are our set of explanatory variables. Each of these categories is constructed as follows:

#### **Movement variables**

This variable is a binary variable and measures the probability of exiting. It is equal to 1 when the firm exits the market the market and 0 otherwise. Table 4 compares the exiting and non-exiting firms across different dimensions.

#### **Firms' variables**

These relate to the specific characteristics of each firm. Some of them act as control variables to avoid bias in the estimation of the parameters of interest. These include industry type, the firm's size, type of legal form, firm's age, capital intensity, revenue growth rate, investment, debts and spending in Research and Development (R&D). A firm's productivity is also used as an explanatory variable. The firm productivity is estimated using the semi-parametric method of Olley and Pakes (see Sarr et al. (2021) for applying semi-parametric estimation methods to measure the firm productivity in Senegal). The firm productivity is added as an explanatory variable. The productivity is measured through in semi-parametric approach as in Sarr and al. (2021). The productivity gap, which is a proxy for the relative productivity of a firm compared to others in the sector, is also included.

#### **Location variables**

According to the literature, the presence of these location variables is justified by their ability to capture the influence of location on firm turnover. This location will be considered according to two scales: administrative level 1 which is "Region" and administrative level

2 corresponding to the department. Only results at administrative 1 are shown here as the results are similar. This approach allows to account for the local industrial structure according to two levels of aggregation and understand under what scale local competition has an impact on the survival of firms. Three location and local competition-related variables are included. The first is the location of firms. The second is the number of companies operating in the sector and the location. The third is the Herfindahl-Hirschman (HH) diversity index, which measures the market's concentration or degree of competition. This was the first calculated sector-location level. It is between 0 and 1, and the more it tends towards 1, the more the market has a monopolistic tendency. The inverse of the HH index is included to make the interpretation more intuitive. Figure provides the density of firms while Table 3 gives some descriptive statistics the variables of interest

### **3.3 Results**

Table 1 presents the estimation results. The results suggest that several firm characteristics are significant. Indeed, a firm's age enters significantly and non-linearly in the cross-section. Indeed, in the context of Senegal, the younger firms are more likely to exit market. However, the higher exit probability of younger firms declines over time. The firm's size plays a crucial role in the probability of exiting. Larger firms in Senegal have a significantly lower probability of exiting. This result is in line with previous findings (Hallward-Driemeier and Thompson 2009b). Moreover, the capital intensity positively affects a firm's probability of exiting, as one previous study in Ghana (Fraser 2005). Interestingly, firms that invest in Research and Development (R&D) are more likely to survive. Indeed, if spending on R&D increases by 1%, the firm probability of exiting declines by 2%. Regarding the firm legal form, this variable is only significant.

Turning to the agglomeration variables and local competition, the results suggest that firms located outside of the capital, Dakar, have a higher probability of exiting than those in Dakar. Moreover, the results indicate the importance of competition in the survival of firms. Indeed, the number of firms in the location-sector and the competition invHHI are significant, reinforcing the importance of competition in firm's survivals.

When it comes to firm productivity, the results indicate that firm productivity plays a crucial role in survival. Indeed, less productive firms have a higher probability of exiting. Surprisingly, the productivity gap displays a negative effect which is counterintuitive.

Table 1. Regression results

Variable	Coefficient
Firm size	
Medium (500M < CA <= 2000M)	0.86
Large (CA > 500M)	0.45***
Firm's Age	0.61***
Firm's Age squared	1.00***
Capital intensity (log)	1.03***
Debt	0.99**
R&D	0.98*
Revenue growth rate	0.99***
Legal form	
Sole	0.84
SA	1.16
Limited Liability	0.99
Limited Liability unique	0.80
AFJ	1.16
Sector	
Trade	0.03***
Industry	0.45***
Services	0.05***
Firm Productivity	0.58***
Productivity gap	0.17***
Location	
Thies	30.40***
Autre	436.38***
Inv HHI	1.05***
Number of firms in sector-region	5.09***
Const	0.00***
Num obs	71,486

Notes: Standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### 4 Is the Cournot model relevant to Senegalese firms and if so, how the profitability derived the Cournot Model affect firm turnover?

##### 4.1 Theoretical and microeconomic model

We follow in Shonkwiler et al. (2014) and consider a constellation of firms that are potential entrants in a market. We assign to each potential entrant a probability of entry—the firm with the highest probability we denote  $p_1$ , the second highest we denote  $p_2$ , and so on. As we do not observe these probabilities directly, so we assume that the log odds of entering the market is given by:

$$\text{logit}(p_i) = \alpha + (i - 1) * \ln(\rho) \quad i = 1, 2, 3, \dots; -\alpha < \alpha < +\alpha; 0 < \rho < 1$$

This probability is increasing in  $\alpha$  and in the proportion  $\rho$ .

Similarly, we assume the log odds of an incumbent of exiting the market is given by:

$$\text{logit}(r_j) = -\alpha + j * \ln(\rho) \quad j = 1, 2, 3, \dots; -\alpha < \alpha < +\alpha; 0 < \rho < 1$$

Exit and entry probabilities are clearly related since they share the two common parameters  $\alpha$  and  $\rho$ .

Since  $\alpha$  and  $\rho$  can be parameterized to depend on conditioning variables. As in Shonkwiler et al. (2014), the proportion  $\rho$  can be considered as an index of turnover because both probabilities are increasing in  $\rho$ . Therefore  $\rho$  might be parameterized to depend on variables related to technological or regulatory change, measures reflecting entry costs and salvage values, and the size of the market. When it comes to  $\alpha$ , higher values of  $\alpha$  increase entry probabilities but decrease exit probabilities. Thus  $\alpha$  might be parameterized to depend on measures related to profitability such as population growth, income growth, and firm density.

Shonkwiler et al. (2014) and Kemp (1997) shown that  $p_i$  and  $r_i$ , are related to counts of firms entering,  $W_i$ , and exiting the market,  $X_i$ . It is shown that the random variable  $Y_i = W_i - X_i$  follows a discrete normal distribution:

$$P(Y_i = y) = \frac{\exp(0.5 * (y - \mu)^2 / \sigma^2)}{\sum_Y \exp(0.5 * (Y - \mu)^2 / \sigma^2)}$$

With  $\mu = \frac{\alpha}{\ln(\rho)} + 0.5$  and  $\sigma^2 = -\frac{1}{\ln(\rho)}$

Our response variables consist of the  $y_{ilt}$  which are the year-to-year changes in the number of firms ( $\Delta N$ ) in sector  $s$  (Construction = 1; Trade=2, Industry=3, Services=4), in the location  $j$  (department admin level), in year  $t$  ( $t = 2008, \dots, 2020$ ). The specification of the hyperparameters  $\mu$  and  $\sigma^2$  is motivated by our previous discussion. Since  $\mu$  is positively related to the number of new firms entering and negatively related to the number of incumbent firms exiting, we hypothesize that for each industry:

$$(S1) \begin{cases} \mu_{ist} = \beta_{0is} + \beta_{1s} \ln(\pi_{ist}) \\ \sigma^2_{ist} = \alpha_0 + \alpha_{2s} * \ln(N_{st}) \end{cases}$$

Where  $\pi_{ist}$  is the firm profit and  $N_{ist}$  is the number of firms for the industry  $s$  for the year  $t$ .

Under the Cournot model that we adopt, the market demand of the form is  $P = \alpha_c - \beta_c * Q$  and the market supply given by  $Q = N * q$ .  $q$  denotes the output of a representative firm in the market and the representative firm profit function may be written  $\pi = (P - c) * q - k$  where  $c$  denotes marginal cost and  $k$  fixed costs. The firm-level profits under the profit-maximizing output of the firm can be derived then:

$$\pi_{max} = \frac{\theta_c * S}{1 + N^2}$$

Thus, firm profits are function of the number of the firms under the Cournot model. (S1) becomes:

$$(S2) \begin{cases} \mu_{is} = \beta_{0is} + \beta_{1s} \ln\left(\frac{\theta_c * S}{1 + N_{st}^2}\right) \\ \sigma^2_{ist} = \alpha_{0s} + \alpha_{1s} * \ln(N_{st}) \end{cases}$$

The estimation of the parameters is done for each sector by maximum likelihood.

## 4.2 Empirical results

Estimated parameters and their robust standard errors are reported in Table 2. First of all, we particularly pay attention to the sign and significance of the estimated  $\beta_{1s}$  parameters as they indicate whether our profitability measures derived from the Cournot model are relevant to the Senegalese firms and economy. The results suggest that our profitability measures are highly significant determinants of firm dynamics (entry and exit movements) for all sectors. Consequently, this indicates that the Cournot model are relevant to the Senegalese firms and economy.

Moreover, we focus on the parameters of dispersion parameters  $\alpha_{2s}$ , which are directly related to firm turnover. The results suggest  $\alpha_{2s}$  parameters are positive as hypothesized and all highly statistically significant for all sectors. Thus, the number of firms numbers are significantly affected the firm turnover.

*Table 2: Structural parameters estimates*

	Construction	Trade	Manufacturing	Services
Determinants of $\mu_{is}$				
$\beta_{1s}$	0.40***	0.54***	0.48***	0.98***
$\beta_{0is}$	1.47***	0,64***	0.55***	1.28***
Determinants of $\sigma^2_s$				
$\alpha_{1s}$	1.02***	2.04***	1.15***	3.72***
$\alpha_{1s}$	0.19***	0.21***	0.22***	0.18***
Notes: *** p<0.01, ** p<0.05, * p<0.1				

## 5 Conclusion

The participation of firms in the creation of wealth and in the economic development of a country put them at the core of many economic policies in Africa. This study focuses on the factors determining the entry and exit of firms in Senegal. More precisely, we explore the impact of productivity, legal status and location on exit and entry decisions. The

analysis uses a total of 18,719 firms from the BDEF covering the period from 2008 to 2020.

The results suggest that in the case of Senegal, age only turns out to have a positive effect above a certain threshold and that before this, being one year older would increase the probability of leaving. In addition, innovation through research and development which is still very low in general has an impact on market exit. Moreover, firms' size has an effect on firm's probability of exiting. In addition, productivity plays an important role in survival risk as the most productive firms are more likely to remain in the market than those with lower productivity.

Our results at the regional level are similar to the results at the department level, which are available upon request. The relevance of an analysis following these geographical divisions can be done thanks to the Herfindahl-Hirschman index. The results indicate that firms experiencing a high concentration in its sector and in a department have less chance of surviving. Therefore, the study's findings confirm the main hypotheses formulated by the passive learning models, namely the positive effect of size and age, and reveal to what extent productivity and location are essential for remaining in a market.

Finally, the paper used a microeconomic model to assess the relevance of the Cournot model to the Senegalese data. The results of our microeconomic model suggest that the Cournot model is relevant to Senegalese firms and the profitability derived from the Cournot model significantly affects the firm turnover for all four sectors considered which are construction, trade, services, and manufacturing.

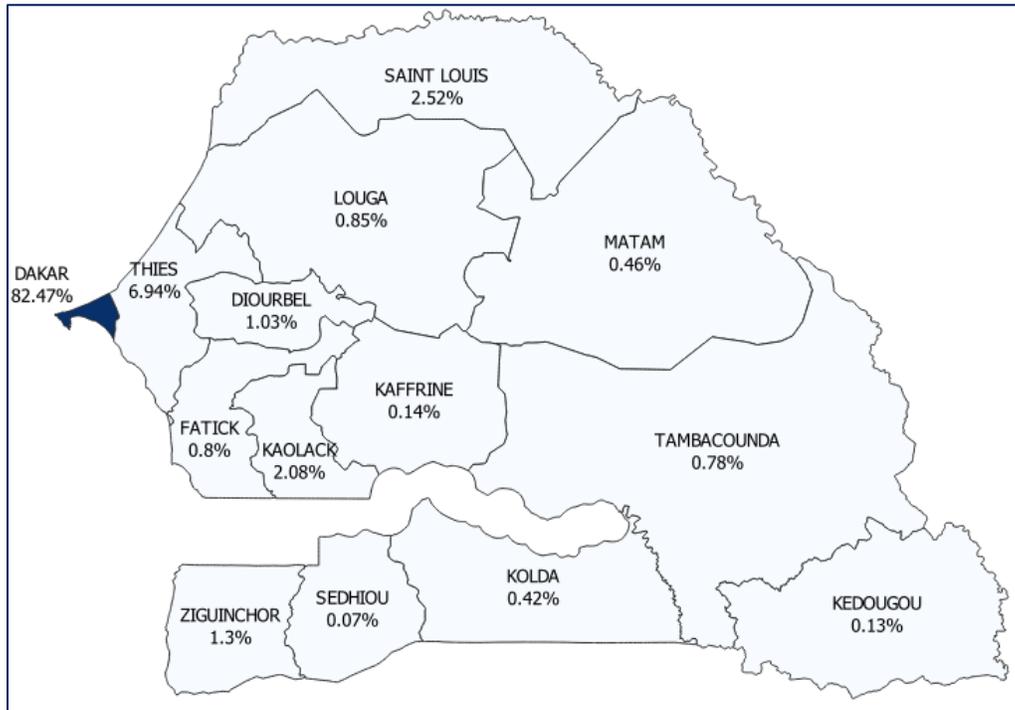
Understanding firms' behaviours and market participation decisions provides valuable insights for evidence-based policymaking. More precisely, understanding how firm productivity, the local environment and competition with sector and location, and legal form affect a firm's probability of exiting in Senegal provides the necessary information for improving the targeting of economic policies and making more accurate predictions of the effects of industry shocks and policy reforms on the economy. It sheds light on the importance of competition in the survival of firms.

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## 6 Annexes

Figure 1. Formal business density



Source: BDEF, author's calculation.

Table 3. Descriptive Statistics

VARIABLES	Observation s	Mean	St	Media
			deviatio n	n
Firms' age	18719	10,82	9,129	8
Firm productivity	14367	0,61	0,9	0,48
Capital intensity	18719	108000 *	6,38*	4,33
Firm revenue	18719	697,5*	7040*	57,2*
Growth rate of the revenue	17201	871,7	49543	9,16
Firm debts	18719	1071*	11100*	38,6*
Spending in R&D	18719	17,26*	1430*	0
Investment	18719	355,9*	48,6*	9,93*
Herfindahl-Hirschman Index at the sector level	18719	0,03	0,0104	0,03
Herfindahl-Hirschman Index at the sector-region level	18714	0,05	0,07	0,036
Herfindahl-Hirschman Index at the department level	18697	0,06	0,08	0,042
Number of firms in the same sector and region	18719	3007	2020	3159
Number of firms in the same sector and department	18719	2268	1597	2292

Table 4. T-test of main variables

<b>Variable</b>	<b>Exit</b>
Firm's age	0.000***
Firm productivity	0.000***
Capital intensity	0.011**
Firm revenue	0.011**
Revenue growth ratee	0.784
Firm debt	0.283
Spending in R&D	0.588
Investment	0.155
Herfindahl-Hirschman Index at the sector level	0.000***
Herfindahl-Hirschman Index at the sector-region level	0.000***
Herfindahl-Hirschman index at the sector-department level	0.000***
Number of firms in the sector- region	0.000***
Number of firms in the sector-department	0.000***